

This listing of claims will replace all prior versions of claims in this Application.

Listing of Claims

Claim 1. (Currently Amended) An electrolytic copper plating solution ~~containing~~ comprising copper, water, water-soluble chlorine compound, a compound having the structure represented by the formula of -X-S-Y-

wherein each of X and Y independently represents an atom selected from the group consisting of a hydrogen atom, a carbon atom, a sulfur atom, and a nitrogen atom, in which X and Y may represent the same only in the case of a carbon atom, and

See B
AK
a thiol-reactive compound chosen from peroxy acids, aliphatic aldehyde compounds, alicyclic aldehyde compounds, aliphatic ketone compounds, alicyclic ketone compounds, hydrogen peroxide and carboxylic acids chosen from formic acid, propionic acid, butyric acid, isobutyric acid, valeric acid, isovaleric acid, oxalic acid, malonic acid, succinic acid, glutaric acid, adipic acid, acrylic acid, methacrylic acid, crotonic acid, maleic acid, fumaric acid, citraconic acid and mesaconic acid.

Claim 2. (Original) The electrolytic copper plating solution according to claim 1, wherein the compound having the structure represented by the formula of -X-S-Y-

wherein each of X and Y independently represents an atom selected from the group consisting of a hydrogen atom, a carbon atom, a sulfur atom, and a nitrogen atom, in which X and Y may represent the same only in the case of a carbon atom, is selected from the group consisting of:

- (1) $M-SO_3-(CH_2)_a-S-(CH_2)_b-SO_3-M$;
- (2) $M-SO_3-(CH_2)_a-O-CH_2-S-CH_2-O-(CH_2)_b-SO_3-M$;
- (3) $M-SO_3-(CH_2)_a-S-S-(CH_2)_b-SO_3-M$;
- (4) $M-SO_3-(CH_2)_a-O-CH_2-S-S-CH_2-O-(CH_2)_b-SO_3-M$;
- (5) $M-SO_3-(CH_2)_a-S-C(=S)-S-(CH_2)_b-SO_3-M$;

(6) $M-SO_3-(CH_2)_a-O-CH_2-S-C(=S)-S-CH_2-O-(CH_2)_b-SO_3-M$;

(7) $A-S-(CH_2)_a-SO_3-M$; and

(8) $A-S-CH_2-O-(CH_2)_a-SO_3-M$

wherein each of a and b represents an integer in the range of 3 to 8; M represents a hydrogen or alkali metal element; A represents one selected from the group of a hydrogen atom, an alkyl group having 1 to 10 carbon atoms, an aryl group, a acyclic or cyclic amine compound consisting of 1 to 6 nitrogen atoms, 1 to 20 carbon atoms, and a plurality of hydrogen atoms, and a heterocyclic compound consisting of 1 to 2 sulfur atoms, 1 to 6 nitrogen atoms, 1 to 20 carbon atoms, and a plurality of hydrogen atoms.

Sub
B1
Cont'd
Claim 3. (Original) The electrolytic copper plating solution according to claim 1, wherein the electrolytic copper plating solution contains 0.1 to 100 mg/L of the compound having the structure represented by the formula of -X-S-Y-.

Claim 4. (Canceled)

Claim 5. (Currently amended) The electrolytic copper plating solution according to claim 1, 4, wherein the thiol-reactive compound is present in the electrolytic copper plating solution in an amount from 1.0×10^{-4} to 1.0×10^{-1} mol/L.

Claim 6. (Currently amended) A process for electrolytic copper plating layer to a substrate using comprising contacting the substrate with the electrolytic copper plating solution according to any one of claims 1 to 5 and applying an anodic current density of 0.1 to 10 A/dm².

Claim 7. (Currently amended) The ~~method~~ process for electrolytic copper plating of claim 6, wherein the substrate is a printed wiring board or a wafer.

Claim 8. (Original) The process for electrolytic copper plating of claim 7, wherein the substrate has a through hole or a via hole.

Claim 9. (Canceled)

Claim 10. (Currently amended) A method for controlling an electrolytic copper plating solution containing comprising copper, water, water-soluble chlorine compound, a the compound having the structure represented by the formula of -X-S-Y-

wherein each of X and Y independently represents an atom selected from the group consisting of a hydrogen atom, a carbon atom, a sulfur atom, and a nitrogen atom, in which X and Y may represent the same only in the case of a carbon atom, and

a thiol-reactive compound chosen from peroxy acids, aliphatic aldehyde compounds, alicyclic aldehyde compounds, aliphatic ketone compounds, alicyclic ketone compounds, hydrogen peroxide and carboxylic acids chosen from formic acid, propionic acid, butyric acid, isobutyric acid, valeric acid, isovaleric acid, oxalic acid, malonic acid, succinic acid, glutaric acid, adipic acid, acrylic acid, methacrylic acid, crotonic acid, maleic acid, fumaric acid, citraconic acid and mesaconic acid,

comprising adding a the thiol-reactive compound to the electrolytic copper plating solution and maintaining a the concentration of the a compound having $-X-S^-$ structure equal or less than 1.0 micro mol/L.

Claim 11. (Original) The method for controlling an electrolytic copper plating solution according to claim 10, wherein the compound having the structure represented by the formula of $-X-S-Y-$ wherein each of X and Y independently represents an atom selected from the group consisting of a hydrogen atom, a carbon atom, a sulfur atom, and a nitrogen atom, in which X and Y may represent the same only in the case of a carbon atom, is selected from the group consisting of:

- (1) $M-SO_3-(CH_2)_a-S-(CH_2)_b-SO_3-M;$
- (2) $M-SO_3-(CH_2)_a-O-CH_2-S-CH_2-O-(CH_2)_b-SO_3-M;$
- (3) $M-SO_3-(CH_2)_a-S-S-(CH_2)_b-SO_3-M;$
- (4) $M-SO_3-(CH_2)_a-O-CH_2-S-S-CH_2-O-(CH_2)_b-SO_3-M;$
- (5) $M-SO_3-(CH_2)_a-S-C(=S)-S-(CH_2)_b-SO_3-M;$
- (6) $M-SO_3-(CH_2)_a-O-CH_2-S-C(=S)-S-CH_2-O-(CH_2)_b-SO_3-M;$
- (7) $A-S-(CH_2)_a-SO_3-M;$ and
- (8) $A-S-CH_2-O-(CH_2)_a-SO_3-M$

wherein each of a and b represents an integer in the range of 3 to 8; M represents a hydrogen or alkali metal element; A represents one selected from the group of a hydrogen atom, an alkyl group having 1 to 10 carbon atoms, an aryl group, a acyclic or cyclic amine compound consisting of 1 to 6 nitrogen atoms, 1 to 20 carbon atoms, and a plurality of hydrogen atoms, and a heterocyclic compound consisting of 1 to 2 sulfur atoms, 1 to 6 nitrogen atoms, 1 to 20 carbon atoms, and a plurality of hydrogen atoms.

Sub
B1
AA
Cont'd
Claim 12. (Canceled)

Claim 13. (New) The electrolytic copper plating solution according to claim 1, wherein the aliphatic aldehyde compounds are chosen from formaldehyde, glutaraldehyde, acetaldehyde, priopionaldehyde, malanaldehyde, succinaldehyde, and glyoxal.

Claim 14. (New) The electrolytic copper plating solution according to claim 1, wherein the peroxo acids are chose from performic acid, peracetic acid, peroxypropionic acid, peroxybutanoic acid and peroxy pentanoic acid.

Claim 15. (New) The electrolytic copper plating solution according to claim 1, wherein the solution comprises copper sulfate, copper cyanide or copper pyrophosphate.

Claim 16. (New) The process according to claim 6, wherein the aliphatic aldehyde compounds are chosen from formaldehyde, glutaraldehyde, acetaldehyde, priopionaldehyde, malanaldehyde, succinaldehyde, and glyoxal.

Claim 17. (New) The process according to claim 6, wherein the peroxo acids are chose from performic acid, peracetic acid, peroxypropionic acid, peroxybutanoic acid and peroxy pentanoic acid.

Claim 18. (New) The process according to claim 6, wherein the solution comprises copper sulfate, copper cyanide or copper pyrophosphate.

Claim 19. (New) The method according to claim 10, wherein the aliphatic aldehyde compounds are chosen from formaldehyde, glutaraldehyde, acetaldehyde, priopionaldehyde, malanaldehyde, succinaldehyde, and glyoxal.